ATTACHMENT TT

MTBE WHITE PAPER

I. Impact of MTBE on Groundwater - C.C. Stanley, W. G. Rixey, and C.Y. Chiang Shell Westhollow Research Lab Houston, TX

MTBE has had an impact on groundwater management at only a few Shell marketing terminals and service stations to date. However, as the usage of this oxygenate begins to increase and as stringent clean-up criteria for MTBE become adopted in more states*, we should anticipate increased concern over how its release to groundwater is managed. Relative to other contaminants, e.g., benzene, toluene, and xylenes, MTBE has a very low partition coefficient from groundwater to soil, therefore plumes move essentially with the groundwater velocity. Present data indicate that MTBE also does not biodegrade in the subsurface environment. Thus, MTBE plumes are expected to move faster and further than the benzene plumes emanating from a gasoline spill. Moreover, the solubility of MTBE is nearly 25 times that of benzene and its concentration in gasoline will be approximately 10 times greater. As a result, more concentrated plumes can be expected.

For illustrative purposes, the groundwater contamination predicted for a gasoline spill of 1000 gallons is shown in Figure 1. A detailed description of how the curves in Figure 1 were developed can be found elsewhere.[1] The 1 ppb isopleths (y, distance from centerline of spill, plotted vs. x, longitudinal distance from the source) for MTBE and benzene at the water table (z=0) are shown for 5 years and 10 years following a spill. (It is assumed that primary recovery of the hydrocarbon source does not occur during this time period). Comparing the 1 ppb contours at year 5, Figure 1 shows how much further the MTBE plume migrates due to the fact that it is not retarded and not biodegraded (a retardation factor of 3 and a degradation rate constant of 0.01 day^{-1} for benzene, and a groundwater velocity of 1 ft/day have been assumed). The plumes at year 10 show continued migration of the MTBE plume, however the benzene plume reaches a steady-state profile after this period of time due to natural biodegradation.

In most spill situations, we are concerned about contaminants reaching receptors (such as a residential well) downstream of the source of the spill. For these cases, MTBE could be the contaminant which triggers remedial action. For the 1000 gallon spill case shown in Figure 1, a receptor 2000 feet from the source would begin to see MTBE in concentrations of 1 ppb, 5 years after a spill. The concentrations at the receptor would then increase and later decrease with time (not shown) as the plume progressed. Benzene, however, would never be detected. Figure 1 also illustrates that when remediation is ultimately required, the area over which recovery wells must be implemented and the volume of groundwater that would need treatment could be several times greater for the MTBE spill than one without MTBE.**

* *See section on clean-up criteria for MTBE in groundwater.*

** *In some cases, e.g., in the case when a spill has been known to have recently occurred, we would like to prevent migration of any contaminant passed the property boundaries. Depending on the size of the spill, MTBE may not be the contaminant which triggers a response. If the spill is large enough (10 to 100 gallons, depending on how much of the gasoline reaches the groundwater table) then benzene as well as MTBE will migrate passed the property boundaries at concentrations greater than 5 ppb. Thus, MTBE would not be the sole reason for remediation.*

II. Clean-up Criteria for MTBE in Groundwater

Clean-up targets for MTBE will be dependent upon whether limits are health-based or due to odor and/or taste constraints.

Health-Based Levels for MTBE in Groundwater

Regarding health-based criteria, the Massachusetts Department of Environmental Protection, Office of Research and Standards recommended a level of 50 ppb for MTBE in 1989.[2] This level was determined from toxicological studies carried out in 1980 for one of the major licensors of MTBE process technology, Chemische Werke Hills, AG.[3] The EPA also issued a drinking water health advisory document recommending a level of 40 ppb for MTBE, based on the results of the same study.[4] These numbers continue to influence our remediation targets at service stations and terminals in Massachusetts and could affect limits for MTBE at locations outside Massachusetts.

A maximum containment level (MCL) has not yet been established by the EPA for MTBE, and it is uncertain what this level may ultimately be. Recent and more comprehensive toxicological studies suggest that a higher limit than that recommended by the Massachusetts Office of Research and Standards is more realistic.[5]

Odor and Taste Threshold Levels for MTBE in Groundwater

At many locations odor and taste criteria may determine clean-up levels. Unfortunately, there are conflicting data regarding the odor threshold for MTBE in water. One study from a large number of cases of contaminated domestic wells concluded that the threshold for MTBE was in the range of 20-50 ppb.[6] However, data developed at WRC established an odor (and taste) detection threshold value of 700 ppb in water for MTBE.[7] The WRC study also established separate odor and taste threshold levels of 7 and 15 ppb, respectively, for Diisopropyl ether (DIPE). A conclusion of the WRC study was that DIPE, not MTBE, was the culprit for odor and taste complaints concerning the drinking water downstream from a gasoline spill at a Shell service station in Rockaway, NJ.

Thus, clean-up targets for MTBE in groundwater could vary from 7 to 700 ppb depending on the presence of other contaminants such as DIPE*, if taste and odor are used as the criteria for remediation.

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* *DIPE will not be present with MTBE at all service stations; only those stations which receive gasoline from manufacturing locations that produce DIPE, a by-product of the manufacture of acetone from isopropanol.*

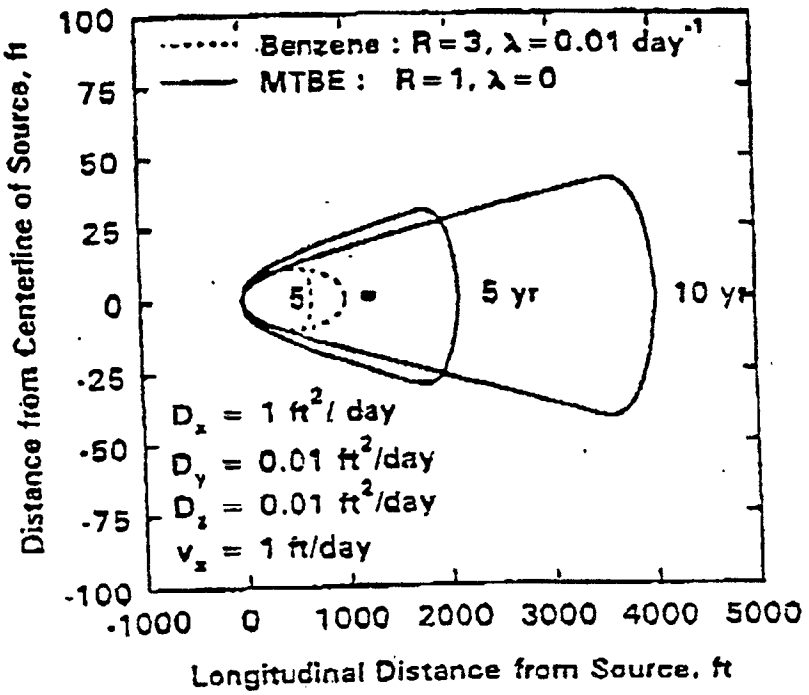

Figure 1. Predicted 1 ppb isopleths for MTBE and Benzene at different times after a 1000 gallon gasoline spill containing 10 % MTBE and 1% Benzene. R is the retardation factor and λ is the biodegradation rate constant. The curves are based on an analytical solution for a homogeneous medium with a constant axial velocity, constant dispersion coefficients, and a time-dependent point source.

References

1 W. G. Rixey, P. M. McAllister, C. Y. Chiang, and C. C. Stanley, Shell Development, Westhollow TPR, to be published.

2 "Massachusetts Drinking Water Guidelines" in Massachusetts Drinking Water Standards and Guidelines, The Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Quality Engineering, Office of Research and Standards, Boston, Massachusetts, October 1989.

3 R. J. Greenough, J. McDonald, P. Robinson, J. R. Cowie, W. Maul, F. McNaughton, and A. Rushon, "Methyl tertiary butyl ether three month inhalation toxicity in rats", Project No. 413038, unpublished report submitted to Chemische Werke Hüls, AG, Marl, West Germany.

4 "Methyl-t-butyl ether Drinking Water Health Advisory", Office of Water, U. S. Environmental Protection Agency, October 1989.

5 J. S. Duffy, J. A. Del Pup, and J. J. Kneiss, *Journal of Soil Contamination*, 1, 29 (1992).

6 P. Garrett, M. Moreau, and J. D. Lowry, "MTBE as a Groundwater Contaminant", in Proceedings of the Conference on Petroleum Hydrocarbons and Organic Contaminants in Groundwater: Prevention, Detection, and Restoration, National Water Well Association, Houston, Texas, November 12-14, 1986, p. 227.

7 D. C. Baker, Shell Development Interoffice Memorandum to B. N. Bastian, July 7, 1981.

CITY OF SANTA MONICA
OFFICE OF THE CITY ATTORNEY

1685 Main Street, Room 310
Santa Monica, California 90401

TELECOPIER TRANSMISSION

DATE: August 24, 1999

PLEASE DELIVER TO: LAURIE WILLIAMS
U.S. Environmental Protection Agency
Office of Regional Counsel

TELECOPIER NUMBER: 510-658-8659

TELEPHONE NUMBER: 510-658-4586

FROM: SANTA MONICA CITY ATTORNEY'S OFFICE

Carol E. Kurtz

TELEPHONE NUMBER: (310) 458-8336
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NUMBER OF PAGES INCLUDING THIS PAGE: _____

RE: MTBE

COMMENTS:

ATTACHMENT UU

United States Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Los Angeles Regional Water Quality Control Board
101 Centre Plaza Drive
Monterey Park, CA 91754-2156

Pete Wilson
Governor

Cal/EPA

July 30, 1998

Mr. Joe Lentini
Shell Oil Products Company
3611 S. Harbor Blvd., Suite 160
PO Box 25370
Santa Ana, CA 92799

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
CLAIM NO. P 442 570 736

METHYL TERTIARY BUTYL ETHER (MTBE) POLLUTION INVESTIGATION OF THE CHARNOCK SUB-BASIN (FILE NO. 96-042, PRP SITE NO. 40). AGENCY REVIEW OF FINAL SITE INVESTIGATION REPORT FOR SHELL OIL PRODUCT COMPANY SERVICE STATION, 3500 CENTINELA AVENUE, LOS ANGELES, CA (FILE NO. 900660052).

Dear Mr. Lentini:

The Los Angeles Regional Water Quality Control Board (Regional Board) and the United States Environmental Protection Agency (USEPA) (collectively, the agencies) have reviewed Shell Oil Products Company's (Shell) subject final report dated June 9, 1998, from Wayne Perry, Incorporated. The subject report was submitted as part of the site specific assessment at the above-referenced facility (site) in connection with the ongoing investigation of methyl tertiary butyl ether (MTBE) pollution impacting the Charnock Sub-Basin. In addition, we have reviewed comments regarding this report submitted on behalf of the City of Santa Monica, and Southern California Water Company, and where appropriate have included these comments.

This agencies' response is composed of four parts, (1) the agencies' review of the final subsurface investigation results, (2) deficiencies in the report that need to be clarified by Shell, (3) the agencies' determinations, and (4) required additional work.

(1) Subsurface Investigation Results

GROUNDWATER

Seven soil test borings were installed between January 5, and January 16, 1998, three of these were converted into groundwater monitoring wells. Groundwater monitoring wells MW-5, MW-9, and MW-10, were constructed with 4-inch diameter PVC pipe. Well MW-5 was screened from 69 to 79 feet below ground surface (bgs), MW-9 and MW-10 was screened from 68 to 78 feet bgs. Monitoring wells were developed by surging and pumping. Groundwater samples were collected on January 22, February 12, and April 22, 1998. Between January and April, 1998, groundwater in MW-5 was approximately 76 feet bgs, groundwater in MW-9 was approximately 79.3 feet bgs, groundwater in MW-10 was approximately 75.6 feet bgs. The saturated thickness of the water bearing strata is recorded by Shell to only be 3 to 5 feet thick. This same zone is interpreted by Shell to be a perched zone above the

Silverado Aquifer. Groundwater in this zone generally flows to the south southwest. The monitoring wells were geophysically logged using conductivity and natural gamma logging methods.

Groundwater samples were collected from all monitoring wells in January 1998, immediately following well installation, but prior to well development (referred to as "discreet depth" samples by Shell). During the "discrete depth" sampling, MTBE was analyzed using EPA Method 8020A with an MDL of 2 μg/L in MW-5 only, and detected at a maximum concentration of 56 μg/L.

The monitoring wells were sampled again (after development) on January 22, February 12, and April 22, 1998. Well MW-10 is the most downgradient well at the site and contaminants in water samples from this well were consistently highest. All groundwater samples from the three on site wells collected after well development contained MTBE, TPH_G, and BTEX. The maximum concentration of MTBE was 12 μg/L (J) in MW-10. TPH_G was detected up to 1,500 μg/L in well MW-10, and BTEX was detected in the same well up to 80 μg/L, 280 μg/L, 66 μg/L, and 340 μg/L respectively.

SOILS

Seven soil test borings were installed between January 5, and January 16, 1998. Soil samples were collected at 5-foot intervals to a depth of 58.5 feet from borings B-5 and B-10, after the 58.5 foot depth, soil samples were collected continuously to the total depth of the borings. Borings B-6, B-7, B-8, and B-11, were collected at 5-foot intervals to their total depth, which was at the capillary fringe of first groundwater. Borings B-5, B-9, and B-10, were terminated at the first competent fine grain unit in the saturated zone and converted to groundwater monitoring wells MW-5, MW-9, and MW-10, respectively. There were a total of 109 soil samples collected for chemical analyses from the seven soil test borings. Boring B-5 was completed to a maximum depth of 80.25 feet bgs and 16 soil samples were collected. Boring B-6 was completed to a maximum depth of 74.75 feet bgs and 15 soil samples were collected. Boring B-7 was completed to a maximum depth of 75.25 feet bgs and 15 soil samples were collected. Boring B-8 was completed to a maximum depth of 75.25 feet bgs and 15 soil samples were collected. Boring B-9 was completed to a maximum depth of 84.75 feet bgs and 17 soil samples were collected. Boring B-10 was completed to a maximum depth of 78.25 feet bgs and a 16 soil samples were collected. Boring B-11 was completed to a maximum depth of 74.75 feet bgs and 15 soil samples were collected.

TPH_G was analyzed with an MDL of 40 μg/kg and detected in 14 out of 109 samples, the maximum TPH_G detected was 530,000 μg/kg in B-6 at 44.75 feet bgs. MTBE was analyzed with EPA Method 8020A using an MDL of 5.0 μg/kg and detected in 26 out of 109 samples. Seventeen of the 26 samples were then re-analyzed for sample confirmation using EPA Method 8260A, and MTBE was confirmed by this method in 12 of the samples. The MTBE concentrations using EPA Method 8020A ranged from 57 μg/kg in B-6 at 34.75 feet bgs up to 1,200 μg/kg in B8 at 25.25 feet bgs. The MTBE concentrations using EPA Method 8260A ranged from 5 μg/kg in B-6 at 19.75 feet bgs to 370 μg/kg in B-7 at 6.25 feet bgs. MTBE was detected at a maximum depth of 60.25 feet at a concentration of 96 μg/kg in B-8. The holding times were greatly exceeded for confirmation samples, for example soil sample B-5 at 19.75 feet bgs was sampled on January 7, 1998, analyzed on January 13, 1998, and MTBE was reported at 14 μg/kg. This sample from B-5 was then re-analyzed for confirmation via EPA Method 8260A on February 18, 1998, 42 days after the sample was collected, the MTBE was reported as not detected with a detection limit of 5.0 μg/kg. Benzene was detected in 14 out of 109 soil samples using an MDL of 1 μg/kg and the concentrations ranged from 1.2 μg/kg (J) in B-7 at 10.25 feet bgs up to 1,100 μg/kg in B6 at 44.75 feet. Toluene was detected in 14 out of 109 samples using an MDL of 1 μg/kg and the concentrations ranged from 1.0 μg/kg (J) in B8 at 25.5 feet up to 11,000 μg/kg in B-6 at 44.75 feet bgs. Ethylbenzene was detected in 15 out of 109 samples using and MDL of 1.0 μg/kg and the concentrations ranged from 1.3 μg/kg (J) in B6 at 24.75 feet up to 6,100 μg/kg in B6 at 44.75 feet bgs.

Total xylenes was detected in 11 out of 109 samples using an MDL of 5 µg/kg and ranged from 6.4 µg/kg (J) in B-6 at 49.75 feet up to 26,000 µg/kg in B-6 at 44.75 feet bgs.

(2) Required Report Revision

Your report must be resubmitted with the following revisions:

1) Shell's final report does not include conclusions of the investigation or recommendations for the site. The agencies requirements clearly specify that this is to be included in the final reports. Your revised report is to include conclusions and recommendations.

2) There was no discussion of the gross exceedance of holding times for many of the soil samples that were to be confirmed by EPA Method 8260. The maximum holding time for these samples is 14 days. Some samples were collected on January 7, 1998, but the respective confirmation samples were not analyzed until as late as February 20, 1998, 44 days later. The agencies consider samples analyzed exceeding the holding time to be low estimates of the original mass of contamination in the soil. Please discuss why these holding times were exceeded.

3) Shell must discuss why the monitoring wells were not constructed as specified in the approved workplan with respect to well screen lengths. The total lengths of the well screens are only 10 feet. This length of well screen does not allow for the specified intervals above and below the water table.

4) Geophysical methods were limited to EM and natural gamma, yet only boring B-9 was continuously cored. Borings B-5 and B-10 were continuously cored and geologically logged below 58.5 feet. The general requirements require all borings to be geophysically logged using nuclear methods (neutron and density) unless continuously cored or sampled.

5) Please clarify why the borings logs indicate that 4-inch schedule 80 well casing was installed, whereas the narrative in your report indicates that 4-inch schedule 40 well casing was installed.

6) Your final report should have included the X, Y, and elevation coordinates for all data points in the report. By letter of June 30, 1998, your consultant Wayne Perry transmitted these coordinates under cover letter referencing the Shell site at 3801 Sepulveda Boulevard. Future coordinate data must be transmitted in the actual final report for the site.

7) Please discuss the significance of MTBE being detected in the equipment blank B8-GW-A.

8) Please describe the calibration procedures used for the field turbidity meter. Please specify if at least one groundwater sample was analyzed for turbidity by a laboratory as specified in the general requirements. Turbidity measurements of less than 5 NTU's were not obtained prior to sampling, please discuss why and what effect this would have on the water quality analyses.

9) Discussion of the site-specific geology should relate recognizable units to the formally named units described in Section 2.2 of your final report.

10) Isoconcentration maps should be provided in map view for soil and groundwater contamination. Isoconcentration drawings in cross section view should also be provided for soil contamination.

11) Table 4 of your final report shows that six soil samples were collected for soil physical analytical

data; however, only one of these samples was analyzed for the required parameters. Please discuss why the other samples were not analyzed.

12) Figure 2 of your final report "Site Location Map" does not show the location of your site, or the Charnock Wellfield, as well as a north arrow. Please revise the map accordingly.

13) You are required to continue groundwater monitoring quarterly for water quality and monthly for water levels. Groundwater level measurements are required to be made on the Monday of the last full week of the month, unless that day is a holiday, in which case gauging is to be done on Tuesday. Quarterly monitoring is to be conducted during the same week during the months of October, January, April, and July.

(3) Agency Determinations

The agencies have determined that this site has discharged gasoline containing MTBE to the soil and groundwater. Due to this discharge, the agencies have determined that this site has contributed MTBE to the Charnock Sub-Basin Investigation Area. As a result, you are required to participate in the Charnock Sub-Basin Regional MTBE investigation and Remediation (Regional Response Effort).

The agencies will forward all parties with responsibility for sites which have contributed MTBE to the Charnock Sub-Basin copies of a draft Consent Decree and Scope of Work for the Regional Response Effort. The agencies have notified Shell of a meeting to be held at the Radisson Hotel in Culver City on July 30, 1998, to discuss the terms of the proposed settlement and scope of work with all parties. In addition, Shell is required to perform additional site-specific work as described below.

(4) Required Additional Work

Shell is required to provide a revised report responding to the above listed required report revisions. Shell is required to implement a quarterly groundwater monitoring program as specified below.

Groundwater Monitoring Program

Prior to collecting groundwater samples, free product thickness must be determined and the depth to water must be measured in all wells to be sampled, then the wells are to be properly purged until the temperature, conductivity, and pH stabilize, and the water is free of suspended and settleable matter, before samples are collected for analysis.

Groundwater samples are to be collected from all groundwater monitoring wells. The groundwater samples and field QA/QC samples (daily equipment and trip blanks) must be analyzed by EPA Method 8015 for TPH_G, EPA Method 8020 or 8240B/8260A for BTEX, including MTBE, TBA, DIPE, ETBE, and TAME. If MTBE is detected it must be quantified using EPA Method 8240B/8260A. All analyses must be performed and reported by a California certified laboratory. Lab QA/QC reports must be submitted in accordance with our Laboratory Requirements for Soil and Water Sample analyses, Charnock Sub-Basin Investigation Area (Appendix C-3, MTBE Pollution Investigation of the Charnock Sub-basin, June 19, 1997), and reported in LabForm 10A.

The quarterly groundwater monitoring reports must be submitted by the fifteenth day following the end of the quarter as shown in the following schedule:

Reporting Period	Report Due Date
January-March	April 15th
April-June	July 15th
July-September	October 15th
October-December	January 15th

The quarterly groundwater monitoring report must include the analytical results of groundwater samples, isoconcentration maps for TPH_G, BTEX, and MTBE, based upon groundwater test results, groundwater contour map depicting the hydraulic gradient and direction of groundwater flow across the site for each saturated zone, and the current groundwater elevation data.

Shell must notify representatives from the Regional Board, USEPA, City of Santa Monica, and the Southern California Water Company as to the schedule for groundwater monitoring activities five days prior to field work per the instructions in the June 19, 1997, letter. Your next groundwater monitoring report (for July-September) is due by **October 15, 1998**. Your revised report is due by **August 10, 1998**.

Agency Authorities

Pursuant to the California Porter-Cologne Water Quality Control Act, Section 13267, Safe Drinking Water Act Section 1431, 42 U.S.C. 300I, and Resource Conservation and Recovery Act (RCRA), Section 7003, 42 U.S.C. Section 6973, Shell is required to (a) participate in the Regional Response Effort, (b) to provide a revised report by **August 10, 1998**, (c) to implement a groundwater monitoring program as specified above.

If you have any questions or need clarifications on any of the items listed above, please contact Mr. David Bacharowski at (323) 266-7546, Mr. Rick Vergets at (323) 266-7556, or Mr. Steven Linder at (415) 744-2036. Please contact Mr. Jorge Leon at (916) 657-2428 or Ms. Laurie Williams at (415) 744-1387 with respect to any legal questions. We look forward to working with you.

Sincerely,

DAVID A. BACHAROWSKI
Environmental Program Manager
Underground Tank Section
California Regional Board

STEVEN C. LINDER, P.E.
Project Manager
Waste Management Division
U.S. EPA Region 9

cc: Jorge Leon, Office of Chief Counsel, SWRCB
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Steve Linder, United States Environmental Protection Agency
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Angelo Bellomo, Environmental Strategies Corporation
Adam Leiter, Wayne Perry Incorporated
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United States Environmental Protection Agency
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CAL/EPA

September 30, 1998

Mr. Joe Lentini
Shell Oil Products Company
Carson Plant
20945 S. Wilmington Avenue
Carson, CA 90810-1039

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
CLAIM NO. Z 237 076 380

METHYL TERTIARY BUTYL ETHER POLLUTION INVESTIGATION OF THE CHARNOCK SUB-BASIN (FILE NUMBER 96-042, PRP SITE NO. 18). SHELL SERVICE STATION NO. 204-4530-0708, AT 10815 NATIONAL BOULEVARD, LOS ANGELES (FILE NO. 900640298). AGENCIES REVIEW OF FINAL SITE INVESTIGATION REPORT.

Dear Mr. Lentini:

The Los Angeles Regional Water Quality Control Board (Regional Board) and the United States Environmental Protection Agency (USEPA) (collectively, the agencies) have reviewed Shell Oil Products Company's (Shell's) Final Site Assessment report for the subject site dated June 2, 1998, submitted by Wayne Perry, Inc. The subject report was submitted as part of the site-specific assessment at the above-referenced facility (site) in connection with the ongoing investigation of methyl tertiary butyl ether (MTBE) pollution impacting the Charnock Sub-Basin. In addition, we have reviewed comments regarding the subject report submitted on behalf of the City of Santa Monica, and Southern California Water Company, and where appropriate have included these comments.

This agencies' response is composed of four parts, (1) the agencies' review of the final investigation results, (2) deficiencies in the report that need to be clarified by Shell, (3) the agencies' determinations, and (4) required additional work.

(1) Subsurface Investigation Results

The recent work detailed in the site assessment report indicates the completion of seven soil borings, three of which were converted into groundwater monitoring wells. An eighth boring (B-15A) met refusal at 10 feet. Borings B-15, B-16, B-17, and B-18, were drilled to the capillary fringe of the first groundwater zone and were extended to between 100.2 and 101.5 feet below ground surface (bgs). Borings/Wells B-12/MW-12, B-13/MW-13, and B-14/MW-14 were terminated in the saturated zone and extended to between 102.2 and 109 feet bgs. Soil samples analyzed from these borings contained total petroleum hydrocarbons as gasoline (TPH_G) in concentrations ranging from non-detect to as high as 26,000 mg/kg in B-16 at 10.25 feet. The MTBE concentrations ranged from non-detect to a maximum MTBE concentration of 120 mg/kg, in B-16 at 10.25 feet bgs. MTBE was detected in 50 of 155 soil samples collected from seven borings. MTBE detection occurred from 5.25 to 85 feet bgs. MTBE was detected in all seven soil borings.

Groundwater was encountered at approximately 102 feet below ground surface (BGS), and the direction of groundwater flow is towards the northwest. MTBE was detected in all three monitoring wells during the April 1998 sampling event and ranged from (using EPA Method 8260) 2.4 µg/L (J) in MW-12 up to 68 µg/L in MW-14. Shell also analyzed samples using the required method detection limits (MDL's) for the required oxygenates di-isopropyl Ether (DIPE) <2 µg/L, ethyl tertiary butyl ether (ETBE) <2µg/L, tertiary amyl methyl ether (TAME) <2 µg/L, and tertiary butyl alcohol (TBA) <50 µg/L. MTBE was the only oxygenate detected. Benzene, toluene, ethylbenzne, and xylenes (BTEX) were also detected in all wells during the April 1998 sampling event. Concentrations of benzene ranged from 7.2 µg/L (MW-12) up to 110 µg/L (MW-14). Toluene ranged from 35 µg/L (MW-12) up to 240 µg/L (MW-14). Ethyl Benzene ranged from 11 µg/L (MW-12) up to 50 µg/L (MW-14). Total xylenes ranged from 69 µg/L (MW-12) up to 260 µg/L (MW-14).

(2) Report Review Comments and Required Report Revision

1) The agecies' General Requirements require all borings to be geophysically logged using nuclear methods (neutron and density) unless continuously cored or sampled. Geophysical methods were limited to EM and natural gamma yet only boring B-13 was continuously cored and geologically logged. Borings B-12 and B-14 were continuously cored below 63.5 and 68.5 feet, respectively. Please explain why all borings were not geophysically logged. Also see comment number 13 below.

2) Soil samples were routinely collected at 5-foot intervals rather than selectively, as required in the General Requirements, at changes in lithology (e.g., 11.25 to 11.75 feet in boring B-13) or at changes in observed moisture or contamination (e.g., 18.75 to 19.25 feet in B-13). Please explain why soil samples were not collected at changes in lithology, soil moisture, or contamination.

3) Shell should clarify whether Schedule 80 PVC casing (as indicated by the boring logs) or 40 PVC casing (as indicated by the text on Appendix A) was used for construction of the three monitoring wells.

4) Shell should provide copies of the original field data sheets from each groundwater sampling event.

5) The calibration procedures for the turbidity meter should be discussed.

6) Shell should clarify if at least one groundwater sample was analyzed for turbidity by a laboratory, as specified in the General Requirements.

7) Shell should provide X, Y, and elevation coordinates for all survey data points in the report.

8) Shell should discuss the significance of MTBE being detected on the equipment blanks B13-GW-A and B-14-GW-A.

9) Shell should include a plume map with concentration isopleths depicting the current known extent of MTBE concentration in the groundwater.

10) Shell should identify and report all laboratory data including results from duplicate (confirmation) samples.

11) Shell should explain why the EQL and MDL were both represented by the same value.

12) Sample holding time for EPA Method 8260 exceeds 14 days. Samples were held up to 29 days for soil samples obtained from boring B-12, 17 days for soil samples obtained from boring B13, and 18 days for soil samples obtained from B16. As a result, the agencies consider MTBE analyses via EPA Method 8260 for these samples invalid and are low estimates of actual contaminant concentrations.

13) Shell states on page 10 that geophysical data was combined with continuous core data for comparative purposes. Please submit the geophysical data interpretation and correlation.

14) The report needs to identify the hydro-stratigraphic units that have been made evident by Shell's investigation. The names of these units, for example, Lakewood Formation, Ballona Aquifer etc., are to be referred to in Shell's report.

15) Figure 6 of the Shell report is a geologic cross section, not a groundwater gradient map as stated in the report on page 16. The groundwater samples taken prior to monitoring well development are shown in Table 6 of the Shell report, not Table 7, as Shell states on page 17. Analytical results of the groundwater samples taken prior to well development are shown on Figure 10, not Figure 9 as Shell states on page 17.

Shell is required to submit a report addendum in response to these comments by **October 30, 1998**.

(3) Agency Determinations

The agencies have determined that this site has discharged gasoline containing MTBE to the soil and groundwater. Due to this discharge, the agencies have determined that this site has contributed MTBE to the Charnock Sub-Basin. As a result, you are required to participate in the Charnock Sub-Basin Regional MTBE investigation and Remediation (Regional Response Effort).

On July 20, 1998, the agencies forwarded all parties with responsibility for sites which have contributed MTBE to the Charnock Sub-Basin copies of a draft Consent Decree and Scope of Work for the Regional Response Effort. In addition, Shell is required to perform additional site-specific work as described below.

(4) Required Additional Work

Additional Groundwater Investigation

Based on the results of this phase of groundwater investigation, it appears that the downgradient extent of groundwater contamination has not been fully delineated. Additional groundwater monitoring wells must be installed to completely delineate the extent of groundwater contamination in order to complete the minimum hydrogeologic assessment required at the site to determine the extent of petroleum hydrocarbon contamination including MTBE, and to determine if site specific remedial action is necessary. You are required to submit a workplan to complete additional hydrogeologic investigation. In addition, you are also required to implement a quarterly groundwater monitoring and reporting program. Future work conducted by your consultant must fully comply with agencies' June 19, 1997, letter and its subsequent addenda. The workplan for additional groundwater investigation is due by **November 2, 1998.**

Groundwater Monitoring Program

Prior to collecting groundwater samples, free product thickness must be determined and the depth to water must be measured in all wells to be sampled, then the wells are to be properly purged until the temperature, conductivity, and pH stabilize, and the water is free of suspended and settleable matter, before samples are collected for analysis.

Groundwater samples are to be collected from all groundwater monitoring wells. The groundwater samples and field QA/QC samples (daily equipment and trip blanks) must be analyzed by EPA Method 8015 for TPH_G, EPA Method 8020 or 8240B/8260A for BTEX, including MTBE, TBA, DIPE, ETBE, and TAME. If MTBE or the other named oxygenates are detected they must be quantified using EPA Method 8240B/8260A. All analyses must be performed and reported by a California certified laboratory. Lab QA/QC reports must be submitted in accordance with our Laboratory Requirements for Soil and Water Sample analyses, Charnock Sub-Basin Investigation Area (Appendix C-3, MTBE Pollution Investigation of the Charnock Sub-basin, June 19, 1997), and reported in LabForm 10A.

The quarterly groundwater monitoring reports must be submitted by the fifteenth day following the end of the quarter as shown in the following schedule:

Reporting Period	Report Due Date
January-March	April 15th
April-June	July 15th
July-September	October 15th
October-December	January 15th

The quarterly groundwater monitoring report must include the analytical results of groundwater samples, isoconcentration maps for TPH_G, BTEX, and MTBE, based upon groundwater test results, groundwater contour map depicting the hydraulic gradient and direction of groundwater flow across the site for each saturated zone, and the current groundwater elevation data.

Shell must notify representatives from the Regional Board, USEPA, City of Santa Monica, and the Southern California Water Company as to the schedule for groundwater monitoring activities five days prior to field work per the instructions in the June 19, 1997, letter. Your next groundwater monitoring report (for July-September) is due by **October 15, 1998**.

Agency Authorities

Pursuant to the California Porter-Cologne Water Quality Control Act, Section 13267, Safe Drinking Water Act Section 1431, 42 U.S.C. 300I, and Resource Conservation and Recovery Act (RCRA), Section 7003, 42 U.S.C. Section 6973, Shell is required to (a) participate in the Regional Response Effort, (b) to provide a workplan for groundwater investigation and report addendum by **November 2, 1998**, (c) to implement a groundwater monitoring program as specified above.

If you have any questions or need clarifications on any of the items listed above, please contact Mr. David Bacharowski at (323) 266-7546, or Mr. Steven Linder at (415) 744-2036. Please contact Mr. Jorge Leon at (916) 657-2428 or Ms. Laurie Williams at (415) 744-1387 with respect to any legal questions. We look forward to working with you.

Sincerely,

David A. Bacharowski

DAVID A. BACHAROWSKI
Environmental Program Manager
Underground Tank Section
California Regional Board

DAB for Steven C. Linder

STEVEN C. LINDER, P.E.
Project Manager
Waste Management Division
U.S. EPA Region 9

cc: Jorge Leon, Office of Chief Counsel, SWRCB
Gary Yamamoto, Drinking Water Field Operations, State Dept. of Health Services
Sean Condry, United States Environmental Protection Agency
Laurie Williams, United States Environmental Protection Agency
Carl Sjoberg, Environmental Programs Division, Los Angeles County Department of Public Works
Capt. Dennis Wilcox, Underground Storage Tank Program, City of Los Angeles Fire Dept.
Keith Pritsker, City Attorney's Office, City of Los Angeles
Walter Crone, Ninyo & Moore
Michael Schwennesen, Ecology and Environment, Inc.
Craig Perkins, Environmental & Public Works, City of Santa Monica

cc: (continued)

Joseph Lawrence, Assistant City Attorney, City of Santa Monica
Rey Rodriguez, Utilities Engineer, City of Santa Monica
Brian Johnson, Underground Storage Tank Program, City of Santa Monica
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Rob Saperstein, Counsel for Southern California Water Company
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Gino Bianchi-Mosquera, Geomatrix Consultants, Incorporated
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Bill Messner, Mobil Oil Corporation
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Los Angeles Regional Water Quality Control Board
101 Centre Plaza Drive
Monterey Park, CA 91754-2156

Pete Wilson
Governor

CAL/EPA

October 28, 1998

Mr. Brad Boschetto
Shell Oil Company - Equiva Services LLC
Carson Terminal
20945 Wilmington Avenue
Carson, CA 90810-1039

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
CLAIM NO. P 442 570 570

METHYL TERTIARY BUTYL ETHER (MTBE) POLLUTION INVESTIGATION OF THE CHARNOCK SUB-BASIN (FILE NUMBER 96-042, PRP SITE NO. 11)
SUBSURFACE INVESTIGATION, AQUIFER PUMP TESTING AND INTERIM REMEDIAL ACTION PLAN FOR MTBE CONTAMINATION AND CLEANUP FOR SHELL SERVICE STATION #204-1944-0100, 3801 SEPULVEDA BOULEVARD, CULVER CITY (I-07099)

SITE ASSESSMENT REPORT DATED JUNE 15, 1998
AQUIFER TESTING REPORT DATED APRIL 30, 1998
INTERIM REMEDIAL ACTION PLAN FOR GROUNDWATER DATED JUNE 23, 1998

Dear Mr. Boschetto:

The Los Angeles Regional Water Quality Control Board (Regional Board) and the United States Environmental Protection Agency (USEPA) (collectively, the agencies) have reviewed the Aquifer Testing Report dated April 30, 1998, the Site Assessment Report dated June 15, 1998, and the Interim Remedial Action Plan dated June 23, 1998, submitted by Wayne-Perry, Inc., on behalf of Shell Products Company (Shell/Equilon/Equiva herein refereed to as "Shell"), for the above-referenced facility (site). These reports were submitted as part of the site specific assessment and evaluation of remedial action alternatives at the site in connection with the ongoing investigation of methyl tertiary butyl ether (MTBE) pollution impacting the Charnock Sub-Basin. The purpose of this letter is to provide the agencies' response to these reports. In preparing these comments, the agencies have considered comments regarding this report submitted on behalf of the City of Santa Monica and Southern California Water Company.

This agencies' response is divided into eight parts; 1) agencies' review of the site assessment report, 2) agencies' review of the aquifer testing report, 3) agencies' review of the interim remedial action plan, 4) deficiencies in the final reports required to be addressed by Shell, 5) agencies' determinations, 6) required additional work, 7) groundwater monitoring program, and 8) agencies' authorities.

1) Site Assessment Report

The recent work detailed in the report titled "Site Assessment Report" dated "June 15, 1998" ("Site Assessment Report") included the installation of twelve groundwater monitoring well clusters. Three well clusters were located on-site and nine well clusters were located off-site. As part of this

investigation, a total of 27 wells were installed throughout the site vicinity (including on-site and off-site locations). At each well cluster, the wells were installed at various depths to determine the groundwater characteristics of a shallow unnamed aquifer (referred to as the "Shallow Unnamed Aquifer" by Shell), and the Upper Silverado Aquifer. A total of 13 wells were installed in the Shallow Unnamed Aquifer, and 14 wells installed in the Upper Silverado Aquifer. Groundwater was encountered at a depth of approximately 80 feet below ground surface (bgs) and has stabilized at approximately 70 feet bgs within the Shallow Unnamed Aquifer. Groundwater was encountered at approximately 110 feet bgs at the interface of the Shallow Aquitard and the Upper Silverado Aquifer, however, groundwater has stabilized at approximately 72 feet bgs. Between June 1996 and June 1998, after groundwater pumping ceased at the Charnock well field, groundwater elevations rose by approximately 19 feet in the Shallow Unnamed Aquifer and 33 feet in the Upper Silverado Aquifer. The direction of groundwater flow indicated by the data collected during the investigation is toward the south southeast in the Shallow Unnamed Aquifer; however, groundwater flow is toward the north-northeast in the Upper Silverado Aquifer. In addition, the variance in the static depth to groundwater in the two aquifers is approximately 3 feet.

Soil test borings were advanced to a maximum depth of approximately 171 feet bgs. Most of the soil borings were continuously cored to determine subsurface lithology and soil characteristics. Soil samples were collected at minimum five foot intervals. Most of the soil borings were geophysically logged using either electro-magnetic induction or spontaneous potential (SP) electrical resistivity, and gamma ray. A total of 154 soil samples were submitted to the laboratory for physical analysis, of which 105 soil samples were analyzed for grain size distribution, 37 samples were analyzed for physical and hydrogeologic properties, and 12 samples were analyzed for Atterberg limits. A total of 225 soil samples were collected and submitted to the laboratory for chemical analysis. Laboratory analysis indicated that 56 soil samples detected MTBE. The highest concentration of MTBE detected in soil was 7,000,000 µg/kg detected in soil boring B18 at a depth of 92 feet bgs (using EPA method 8020) and the deepest detection of MTBE in soil was 130 µg/kg in soil boring B17M at a depth of 146 feet bgs (using EPA method 8020).

As part of this investigation, a total of 115 groundwater samples were collected and submitted to the laboratory for chemical analysis. Laboratory analysis indicated that 48 groundwater samples detected MTBE. The highest concentration of MTBE detected in groundwater during the investigation was 230,000 µg/L (using EPA method 8260A). That groundwater sample was collected from the Shallow Unnamed Aquifer from groundwater monitoring well MW-15S immediately after the well was developed. The highest concentration of MTBE in the Upper Silverado Aquifer was reported to be 27,000 µg/L (using EPA method 8020) for a sample from MW-11M collected two weeks after well development. In addition, the highest concentration of tertiary butanol (TBA) was detected at 17,000 µg/L (using EPA method 8260A), detected in a groundwater sample collected from MW-15S. During the last round of groundwater sampling completed on April 20, 1998, the highest MTBE concentration detected was 56,000 µg/L using EPA method 8020 (45,000 µg/L using EPA method 8260A) in groundwater monitoring well MW-18S. Since the installation of the groundwater monitoring wells, groundwater samples have been collected at selected wells for a total of upto six sampling events.

Therefore, it is apparent that high concentrations of gasoline constituents including MTBE and TBA have migrated off-site into the Shallow Unnamed Aquifer and the Upper Silverado Aquifer. The location of the contaminants, including MTBE and TBA, indicates they have traveled in the direction

of the Charnock Wellfield. The report indicates that separate phase hydrocarbons (free product) were removed from the site during the period from October 1993 to October 1996, at which time the free product was no longer observed in on-site wells. However, the existing concentrations of MTBE and TBA in groundwater, together with that of other gasoline range hydrocarbons identified in on-site and off-site soil borings indicate that these areas are ongoing sources of $TPH_{(G)}$, BTEX, MTBE, and TBA to soil and groundwater contamination.

The report also documents that a number of existing groundwater monitoring wells and soil vapor extraction wells (MW-1/VE-1, MW-2/VE-2, MW-3, MW-4/VE-6, MW-5/VE-7, VE-5, and VE-8) were destroyed because they were determined to be screened across the Shallow Unnamed Aquifer and into the Upper Silverado Aquifer. These wells were destroyed by over-drilling and backfilling the borings with cement bentonite grout to prevent further migration of contaminants from the Shallow Unnamed Aquifer into the Upper Silverado Aquifer.

2) Aquifer Pump Testing Report

Aquifer pump tests were performed in the Shallow Unnamed and Upper Silverado aquifers to collect hydraulic data, which will be used to determine the appropriate maximum pumping rates the aquifers can support during extraction of contaminated groundwater. The test suite included a series of step-drawdown/recovery tests (step tests), and two constant-rate/recovery tests. The pumping tests were performed in groundwater monitoring wells MW-11S in the Shallow Unnamed Aquifer, and MW-11M in the Upper Silverado Aquifer. Groundwater Monitoring well MW-11S is screened from 67 to 102 feet bgs, and well MW-11M is screened from 108 to 118 feet bgs. For the aquifer pump test data collection, groundwater monitoring wells 7S, 8S, 12S, 13S, 14S, and 15S in the Shallow Unnamed Aquifer, and groundwater monitoring wells 7M, 8M, 12M, 13M, 15M, 16M, 17M, and 18M in the Upper Silverado Aquifer were used. The step tests were performed in the Upper Silverado Aquifer at an initial flow rate of 15 gallons per minute (gpm), a final flow rate of 22.5 gpm, and a maximum flow rate of 30 gpm. While pumping at 30 gpm, the groundwater elevation in the pumping well MW-11M dropped to a depth of 100 feet bgs, approximately to the top of the fine grained layer separating the two aquifers. In the Upper Silverado Aquifer, at a maximum flow rate of 30 gpm, a draw down of 25.6 feet was observed in the pumping well MW-11M. Step tests performed in the Shallow Unnamed Aquifer were performed at an initial flow rate of 25 gpm, a maximum flow rate of 75 gpm, and a final flow rate of 60 gpm. At a maximum flow rate of 75 gpm, a draw down of 9.6 feet was observed in the pumping well MW-11S.

The constant rate tests were performed at flow rates of 65 gpm in the Shallow Unnamed Aquifer in groundwater monitoring well MW-11S; and at a flow rate of 20 gpm in the Upper Silverado Aquifer in groundwater monitoring well MW-11M. Following cessation of pumping, electronic and manual gauging was continued to monitor the recovery of the Shallow Unnamed Aquifer and the Upper Silverado Aquifer until the groundwater recovered to a minimum of 95 percent of pre-pumping levels. Groundwater draw down was logged using electronic data loggers and manually using interface probes to determine the accuracy of the data loggers. For the aquifer test, data loggers were placed in 21 groundwater monitoring wells located in both aquifers. The wells were selected such that they provided information on draw down at various distances from the pumping wells. At the end of the pump test the data were interpreted using the Theis Unconfined Approximation Method, and the

Cooper-Jacob Straight-Line Method for the Shallow Unnamed Aquifer. The Theis Method for Confined Aquifers, the Cooper-Jacob Straight-Line Method, Confined Aquifer Recovery Methods of Kruseman and de Ridder), the Hantush and Jacob Leaky Aquifer Method, and the Hantush Method for a Leaky Aquifer with Stroage Changes in the Confining Bed were used to analyze the data from the Upper Silverado Aquifer. Analysis of the aquifer pump test data using these methods stated above indicate that the Shallow Unnamed Aquifer is an unconfined aquifer, and that the Upper Silverado Aquifer is a leaky confined aquifer.

3) Interim Remedial Action Plan

The Interim Remedial Action Plan (RAP) proposed groundwater cleanup only and does not address soil remediation at this time. Historically, free product has been observed in some of the groundwater monitoring wells installed at the site. Free product removal was conducted between October 1993 through October 1996, at which time free product was no longer observed in the on-site wells. Approximately 1,370 gallons of free product was reportedly removed as part of the free product recovery (source removal) program. In addition, soil vapor extraction was implemented at the site in August 1995 and continued operation until August 1997. During the two years that the vapor extraction system operated, approximately 14,365 gallons of gasoline-equivalent fuel hydrocarbons were reportedly removed from the subsurface.

Shell analyzed various treatment options before recommending a treatment option that it considers economically and technologically feasible. Five remedial options were considered: 1) no action, 2) institutional controls, 3) in-situ treatment extraction, 4) treatment and re-injection of treated groundwater and 5) extraction, treatment and discharge of treated groundwater to the storm drain system. Shell considers option 5 to be the most feasible option. Groundwater treatment technologies considered were: activated carbon adsorption (liquid phase), air stripping with off-gas treatment, advanced oxidation, biological treatment, and membrane/CO_2 adsorption. After selection of three technically feasible technologies, pilot scale tests were performed at the site using ultraviolet light/hydrogen peroxide (UV/H_2O_2), ozone/hydrogen peroxide (O_3/H_2O_2) (both advanced oxidation treatment technologies), and air stripping. Shell proposed air stripping with off-gas treatment using a recuperative thermal oxidizer as the treatment technology, with pretreatment using H_2O_2 to remove the soluble iron and manganese, and liquid phase carbon as a final polish prior to discharge. In addition, Shell has proposed to use advanced oxidation treatment technology to remove TBA from the groundwater. As proposed, the advanced treatment unit will be placed after the air stripper in order to treat the TBA specifically. Shell must provide complete details on any changes to the proposed treatment system for review and evaluation in advance of the startup of the remediation system.

4) Required Report Revisions

A. Site Assessment Report

1) Shell shall revise the subsurface investigation report to include a discussion of the historical use of MTBE and other fuel oxygenates at the site.

2) Shell shall revise the report to include a discussion of any deviations from the approved workplans and addendum's.

3) Shell shall revise the report in order to indicate that, during UST removal and replacement in June 1992, tank #2 had a 6-inch "rot" at the base of the tank and a crack near the middle of the tank. Discuss this information in greater detail.

4) In the narrative of the report, it is indicated that eight previously installed wells were destroyed and refers the reader to Figure 2. However, according to the legend on Figure 2 only three wells have been destroyed. Please revise this figure to show all the destroyed wells.

5) The report defines the geology and hydrogeology and describes the distribution of MTBE in the Shallow Unnamed Aquifer and the Upper Silverado Aquifer beneath the station and the area surrounding the station. However, the report does not include discussion, interpretation, conclusions and recommendations related to contaminant hydrogeology, including contaminant migration pathways, and distribution of MTBE and TBA in the aquifers. Provide this information in the addendum to the Site Assessment Report.

6) The report indicated that separate phase hydrocarbons were removed from five wells between October 1993 and October 1996. Please provide the measurement data for separate phase hydrocarbons and total volumes removed from each well over time. Additionally, discuss the disposition of the separate phase hydrocarbons removed from these wells.

7) Revise the report to include data and a detailed discussion of the geophysical survey results.

8) The report does not incorporate geologic, stratigraphic, and hydrogeologic data from the surrounding sites and from the Regional Investigation. Please provide this information in the addendum to the Site Assessment Report.

9) Figures submitted in the report do not show isoconcentration maps for $TPH_{(G)}$, benzene, and MTBE in the soil at specific depths and in the Shallow Unnamed and Upper Silverado Aquifers. The cross sections do not depict $TPH_{(G)}$, benzene, and MTBE concentrations in the soil and the groundwater. Please provide this information in the addendum to the Site Assessment Report.

10) Laboratory analysis of groundwater samples collected prior to well development and post-development indicated considerable variation. Discuss the potential causes and significance of this phenomenon in greater detail in the revision to the Site Assessment Report.

11) Laboratory analysis of some of the Quality Assurance/Quality Control (QA/QC) samples indicated presence of significant amounts of MTBE. Please provide an explanation for each of the instances where this has occurred, the reasons for these occurrences and their overall impact on the results of the laboratory analysis on the

samples (soil & groundwater) collected and transported in each of these batches sent to the testing laboratory.

12) Revise figures 17 through 22 to include arrows showing direction of groundwater flow.

13) Provide X, Y and elevation coordinates for all the data points in relation to a common reference survey point.

14) The report does not provide a rationale for destroying and replacing the former vapor and/or groundwater monitoring wells. These wells were cross-screened between the Unnamed Shallow Aquifer and Upper Silverado Aquifer, thereby acting as conduits for contaminant transport. Shell must include and expand upon this information in the report.

15) The report indicates that the groundwater is flowing towards the south-southeast in the Shallow Unnamed Aquifer; and that it is flowing towards the north-northeast in the Upper Silverado Aquifer. Explain this phenomena and indicate why this is being observed at this site.

16) The extent of groundwater contamination has not been fully defined in the direction of the Charnock Wellfield; however, Shell has performed significant amounts of investigation as part of a regional investigation. Data obtained from the regional investigation must be incorporated in the report to show the extent of separate phase (if any), dissolved phase hydrocarbon (including $TPH_{(G)}$, BTEX, MTBE and TBA) plume migration from the Shell site and complete plume delineation.

B. Aquifer Pump Testing Report

1) The Aquifer Pump Testing Report must have an additional objective of assessing possible boundary conditions. Please provide this information in a revised Aquifer Pump Testing Report.

2) On Graph 13, the data in the "call-out boxes" for the start and end of test, appear to be in error. Correct this graph.

3) In section 4.2.2. the report discusses the effects of borehole storage on aquifer tests and presents an equation to determine the duration of the test; however, the discussion is not related to the wells and pumping for this study. The revised report must contain conclusions regarding the sufficiency of the aquifer test given the construction of the pumping wells and duration of the aquifer test.

4) Shell shall revise section 5.1 to correct the references to Appendices B and C which should actually be Appendices C and D. Correct any other erroneous references to appendices in various subsections of section 5.2.

5) The Aquifer Pump Testing Report presented several equations to assess the validity of certain assumptions for specific analytical methods. However, the report does not analyze whether the assumptions required by certain analytical methods are reasonable in light of the data. Please provide this information in the revised Aquifer Pump Testing Report.

6) Shell shall provide a comparison and evaluation of aquifer characteristic data interpretation results obtained from the tests (step down and constant pumping) using different analytical methods establishing the most appropriate method(s) for the site-specific hydrogeologic conditions.

7) Shell must revise the Aquifer Pump Testing Report to include figures and discussion of the spatial distribution of draw-down measured during each aquifer test. The analysis of the data shall discuss the observed patterns or the resultant transmissivities which suggest anisotropy. In addition, provide a summary of other parameters determined from these tests such as Kh/Kv and aquitard leakage.

8) Because significant draw-down (during Charnock Sub-basin pumping) and rebound (during non-pumping condition) has been observed, the leaky confined conditions of the Upper Silverado Aquifer determined during this limited aquifer test may not accurately reflect the hydraulic condition of the Upper Silverado Aquifer during the full scale pumping of the Charnock Sub-basin. Therefore, the report must be revised to include a discussion of the likely conditions that may occur within the Upper Silverado Aquifer during the full scale pumping of the Charnock Sub-Basin by the City of Santa Monica and Southern California Water Company.

9) The report does not present all the data from the aquifer testing in either draw-down, rebound or water level hydrographs during test. These plots would be very helpful in assessing the success of removing non-test trends. Shell shall provide hydrographs for the Shallow Unnamed Aquifer during the testing of the Upper Silverado Aquifer and vice versa.

10) The report indicated that barometric corrections were not warranted following the review of the filtered data. However, it is not clear that the data used to reach that conclusion is represented in this report. Shell shall provide the evidence and analysis which supports Shell's conclusion that barometric corrections are not needed.

11) The report indicates that communication between the aquifers across the aquitards did not occur; however, there is no supporting data. Provide monitoring data from each aquifer during pumping conditions which demonstrates that there was no hydraulic conductivity between the Shallow Unnamed Aquifer and the Upper Silverado Aquifer.

12) All aquifer transmissivities (T) must be converted to aquifer hydraulic conductivity (K).

13) Shell shall revise the Aquifer Testing Report to include conclusions concerning the consistency between the calculated aquifer properties and the lithologies present within the tested hydrostratigraphic units.

14) In Section 3.3 of the Aquifer Testing Report (Water Treatment and Discharge), Shell must either discuss the effectiveness of water treatment to achieve discharge requirements or direct the reader to a reference (an appendix or agency submittal) that contains the results of the influent and effluent monitoring described in this section.

C. Interim Remedial Action Plan

1) The interim remedial action plan is for the cleanup of groundwater contaminated with $TPH_{(G)}$, BTEX compounds, and MTBE, however, it does not address the cleanup of TBA found in the groundwater underneath the site at concentrations as high as 17,000 ppb. As you know, TBA is currently being detected in the City of Santa Monica Charnock Well No. 19 at concentrations ranging from 3 to 5 µg/L. During a meeting held at this Regional Board on October 1, 1998, between Dr. Chi-Su Chou and Mr. Paul McCullough of Wayne Perry, representing Shell and Mr. David Bacharowski, Mr. Yue Rong, and Mr. Harry Patel of the Regional Board, and teleconference with Mr. Steven Linder and Mr. Greg Lovato of USEPA, Shell proposed to add a UV/H_2O_2 unit to the treatment train after the air stripper to remove the TBA from the groundwater prior to discharge to the storm drain.

Shell must provide a revised remedial action plan (RAP) by **November 16, 1998,** which contains the following information: a) treatment system modification and changes necessary to add the UV/H_2O_2 unit to the treatment train; b) complete flow diagram of the entire treatment train; c) the names of manufactures and system installation and operational information for the UV/H_2O_2 unit (i.e. flow rates, lamp wattage and orientation, feed rates and dosing for hydrogen peroxide, residence time, number of cycles for removal of TBA, etc.). Additionally, Shell must provide the anticipated level of removal of $TPH_{(G)}$, BTEX, MTBE, and TBA, along with presentation and justification for proposed allowable concentrations of these compounds in discharges to the storm drain.

2) Because of the high contaminant concentrations present in the vadose zone and dewatered strata, the agencies consider both additional source investigation and soil remediation to be mandatory components of an interim response action at the site at this time. Shell must prepare an additional interim RAP by **December 18, 1998,** which includes provision for additional source control in the form of soil remediation (e.g., soil vapor extraction). Components of the source investigation should include: 1) a determination of whether the operating tank systems at the site are currently leaking, 2) a detailed summary of the TBA content in fuels currently and previously managed at the site, and 3) the need for additional soil remediation.

3) The RAP needs to specify if the "iron fouling bacteria" are iron oxidizing, iron reducing, or both. Shell must identify samples that have been collected and analyzed

for galleonella, thiobacillus, or other bacteria known to use iron in their energy cycle. Clarify if the addition of hydrogen peroxide to precipitate iron and magnesium will also reduce the "iron fouling bacteria" concentrations.

4) In section 3.3.1.1, the narrative of the RAP indicated that the highest MTBE concentrations recorded in the most recent groundwater sampling was 58,000 µg/L, however, Table 2.8 and figure 34-21 indicated MTBE concentration of 56,000 µg/L. Correct this typographical error.

5) In section 4.0 of the RAP, the wells selected for pumping in the Shallow Unnamed Aquifer and the Upper Silverado Aquifer are different from the wells indicated in section 5.2. Please clarify if this is an error and indicate which wells will be used in the Shallow Unnamed Aquifer and the Upper Silverado Aquifer for groundwater pump and treat operations.

6) Given the range of water quality parameter values presented in Table 5-4, in particular pH, hardness and bicarbonate alkalinity, Shell must revise the RAP to include an evaluation of the water quality in relation to the Langelier saturation index and the potential for scale formation in the treatment system(s).

7) Indicate if there is any increase in MTBE removal noted for an air/water ratio of 300:1 versus air/water ratio of 200:1 in the case of heated groundwater air stripping. Discuss the advantages of heating the groundwater prior to air stripping.

8) In Index B of the RAP report indicates that Geomatrix used the regional groundwater flow model to develop a local groundwater flow model. Shell also has indicated that "refinements" of the regional model were still in progress at the time of this report. Therefore, Shell must provide information identifying how the planned refinements to the regional model will require refinements to the localized model.

9) Shell must revise the RAP to include cross-sectional views of the model through the extraction wells to indicate their depth of influence.

10) Shell must revise the RAP to include a provision for future evaluation of the interim remedy performance, in the event future remedial activities (at the site or neighboring sites) are implemented which impact the interim remedy performance. For example, such an evaluation would include analysis of modified groundwater flow patterns in the event additional pump and treat systems are installed.

11) The RAP has indicated that the groundwater has been encountered in the Shallow Unnamed Aquifer because of shut down of production wells in the Charnock Sub-basin. The report must be revised to include a discussion the effect on remediation activities if the Shallow Unnamed Aquifer were to go dry once the production wells in the Charnock Sub-basin are in operation again.

12) Figures 4-1 and 4-2 must be amended to include the groundwater elevation contours during pumping. The report must define hydraulic control for the Shallow Unnamed Aquifer and the Upper Silverado Aquifer in terms of specific well screen depth locations and drawdown level targets. The report must contain a performance monitoring protocol (location and frequency of measurements and method of analysis) to be used during extraction which will demonstrate hydraulic control.

13) The RAP must be revised to contain process design drawings that can help the agencies in determining the treatment process, the sampling point locations, and the waste stream points. The RAP also must provide a preliminary mass balance for the treatment process.

14) The revised RAP must contain a description of project management, including: levels of authority and responsibility, lines of communication and a description of the qualification of key personnel who have directed and will direct the interim measure design and implementation effort (including contractor personnel).

15) The RAP must contain a description of site safety and security provisions (e.g., fences, fire control, etc.) and a description of potential safety hazards and provisions for mitigation of such hazards.

5) Agency Determinations

Based on the laboratory analysis of the soil and groundwater samples collected, there are significant quantities of petroleum hydrocarbons containing BTEX compounds and gasoline additives including MTBE and TBA in the soil and groundwater. The agencies have determined that this site has discharged gasoline containing MTBE and TBA to the soil and groundwater. MTBE and TBA contaminated groundwater has migrated off site beyond existing groundwater monitoring wells MW-16S, MW-16M, MW-19S, and MW-19M. Due to this discharge, the agencies have determined that this site has contributed MTBE affecting the Charnock Sub-Basin. As a result, Shell is required to participate in the Charnock Sub-Basin Regional MTBE Investigation and Remediation. Furthermore, the agencies conditionally approve the interim remedial action plan (dated June 23, 1998) as proposed, provided that all items specified in Section 4, part C above are addressed in a written form and submitted to the agencies by **November 16, 1998** (prior to startup of the remediation).

6) Additional Work Requirements

The extent of soil and groundwater contamination has not been fully defined in the Shallow Unnamed Aquifer in the down-gradient direction (south southeast) of the existing groundwater monitoring wells MW-8S, MW-14S, and MW-17S, laterally and upgradient (northeast) of existing groundwater monitoring wells MW-13S and VE-4. Similarly in the Upper Silverado Aquifer, the extent of groundwater contamination has not been defined down-gradient (north) of existing groundwater monitoring wells MW-9M, and MW-16M.

Shell is required to install in the Shallow Unnamed Aquifer, at least two additional groundwater monitoring wells in the areas downgradient of the existing groundwater monitoring wells MW-

7S/MW-14S and downgradient of MW-17S. In addition, Shell is required to install at least two groundwater monitoring wells in the Upper Silverado Aquifer downgradient of existing groundwater monitoring wells MW-9M and MW- 16M. This additional investigation must be performed in accordance with previously approved workplans and protocols for the site. If the test results from these downgradient wells identify gasoline constituents including any additives, additional groundwater monitoring wells must be installed at that time. The revised report along with a workplan for additional hydrogeologic investigation is due by **November 16, 1998**. Please provide these documents as separate reports for agencies' review and approval.

7) Groundwater Monitoring Program

Shell must initiate a quarterly groundwater monitoring and reporting program. Prior to collecting groundwater samples, free product thickness (if any) must be determined and the depth to water must be measured in all the wells to be sampled, then the wells are to be properly purged until the temperature, conductivity, and pH stabilize, and the water is free of suspended and settleable matter, before samples are collected for analysis.

As part of the quarterly groundwater monitoring program, groundwater samples must be collected from all the groundwater monitoring wells. The groundwater samples and field QA/QC samples (daily equipment and trip blanks) must be analyzed by EPA Method 8015 for $TPH_{(G)}$, EPA Method 8020 or 8240B/8260A for BTEX. MTBE and other fuel additives [TBA, di-isopropyl ether (DIPE), ethyl tertiary butyl ether (ETBE), and tertiary methyl ether (TAME)]. All analysis must be performed and reported by a California certified laboratory. Laboratory QA/QC reports must be submitted in accordance with our Laboratory Requirements for Soil and Water Sample Analysis, Charnock Sub-Basin Investigation Area (Appendix C-3, MTBE Pollution Investigation of the Charnock Sub-basin, June 19, 1997), and reported in LabForm 10A.

The quarterly groundwater monitoring must be submitted by the fifteenth day following the end of the quarter as shown in the following schedule:

Reporting Period	Report Due Date
January-March	April 15th
April-June	July 15th
July-September	October 15th
October-December	January 15th

The quarterly groundwater monitoring report must include the analytical results of groundwater samples, isoconcentration maps for $TPH_{(G)}$, BTEX, MTBE and TBA. Based upon groundwater test results, Shell must draw groundwater contour maps for those compounds, a contour map depicting the hydraulic gradient and direction of groundwater flow across the site for each of the aquifers, and the current groundwater elevation data.

Shell must notify representatives from the Regional Board, USEPA, City of Santa Monica, and the Southern California Water Company as to the schedule for groundwater monitoring activities five days

prior to field work per the instructions in the June 19, 1997, letter. Your groundwater monitoring report (for October-December) is due by **January 15, 1999**.

8) Agency Authorities

Pursuant to California Porter-Cologne Water Quality Control Act, Section 13267, Safe Drinking Water Act Section 1431, 42 U.S.C. 300I, and Resource Conservation and Recovery Act (RCRA), Section 7003, , 42 U.S.C. Section 6973, Shell is required to; (a) provide revised reports (site assessment report addendum, aquifer testing report and the interim remedial action plan) which address the agencies' comments in section 4 of this letter by **November 16, 1998.** (b) provide a workplan for the installation of additional soil borings and completing them as groundwater monitoring wells by **November 16, 1998**, (c) implement a groundwater monitoring program as specified above, and (d) provide a soil remediation interim remedial action plan by **December 18, 1998**.

If you have any questions or need clarification on any of the items listed above, please contact Dr. Yue Rong at (323) 266-7604, Mr. Harry Patel at (323) 266-7556, or Mr. Steven Linder at (415) 744-2036. Please contact Mr. Jorge Leon at (916) 657-2428 or Ms. Laurie Williams at (415) 744-1387 with respect to any legal issues. We look forward to working with you.

Sincerely,

David A. Bacharowski

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cc: Jorge Leon, Office of Chief Counsel, SWRCB
Gary Yamamoto, Drinking Water Field Operations, State Dept. of Health Services
Greg Lovato, United States Environmental Protection Agency
Laurie Williams, United States Environmental Protection Agency
Jim Munch, State Water Resources Control Board, Underground Storage Tank Cleanup Fund
Carl Sjoberg, Environmental Programs Division, Los Angeles County Department of Public Works
Keith Pritsker, City Attorney's Office, City of Los Angeles
Walter Crone, Ninyo & Moore
Michael Schwennesen, Ecology and Environment, Inc.
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Joseph Lawrence, Assistant City Attorney, City of Santa Monica
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Jennifer Colvard, Exxon Company USA
Kim Burns, Conoco Incorporated
Joe Lentini, Shell Oil Products Company
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Don Kemp, Culver City Public Works
Mike Van der Platts, Tosco/76 Products Company
Bruce Albertson, Albertson Oldsmobile
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